In the above 6 cases the phenolsulphonephthalein test showed that the excretion of this substance was entirely normal, save in two instances. In one, the case of W. E. S., it was 5 per cent. lower than the usually accepted normal. In the other, the case of H. W., it was 14 per cent. lower with the patient standing, than when made in the recumbent position. The latter observation is in accord with Jeble's studies of the salt and water excretion. However, in the case of J. A., is is to be noted that there was no reduction in the amount of the dye recovered in the urine, even when the conditions producing oliguria and the maximum degree of albuminuria were present.

The observation of a larger number of cases will be necessary before definite conclusions can be drawn in regard to this point. Unfortunately, a comparison of the excretion in the recumbent and in the erect posture was not made in the other four patients.

In this connection we may mention the case of a young man sent for study because of supposed renal disease. Our examination of the urine revealed no abnormalities either in the recumbent or in the erect position. The lumbar lordosis was a little exaggerated, however, and on making the patient stand in a purposely exaggerated lordotic position for one-half hour he excreted a trace of albumin and a few hyaline casts. The phenolsulphonephthalein test was made with the patient recumbent, and again in the ordinary erect posture. The amount excreted in the recumbent position was for the first hour, 58 per cent.; for the second hour, 20 per cent.; total, 78 per cent.; while that put out while standing erect was for the first hour, 57 per cent.; for the second hour, 13 per cent.; total, 70 per cent. We do not regard a difference of 8 per cent. of great significance, especially when the readings are high, as in this case.

We should like to call attention, in the instance of H. W., to the fact that a collargol Roentgen-ray plate of the right kidney showed a definite prolapse, with kinking of the ureter, and some hydronephrosis; and we would suggest that, in certain instances, at least, a movable, or a prolapsible, kidney may be a factor in so-called orthostatic albuminuria.

THE EFFECT OF WATER INTAKE ON NITROGEN RETENTION IN NEPHRITIS.

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The notable fact which has been established by study of the metabolism of patients with nephritis, is that there are periods

when organic and inorganic substances are retained in the body to a degree not evident in health. Whether this accumulation be dependent upon an inability of the kidney to excrete these substances, as some believe, or whether these substances are retained in the tissues bound in some abnormal combination, is not at present clear. The net result, however, is the same in that balances between intake and output are either difficult to achieve, or at periods quite impossible. In the nature of the factors operating to effect this retention, we come to one of the fundamental questions in pathological metabolism, concerning which our conceptions are vague and, for the most part, devoid of support. The relation of sodium chloride to edema may be cited as an example. Is the salt retained in the tissues, or is there a failure of the kidney to excrete? Is it the sodium or the chlorin that is the immediate factor, or is the whole question one of water retention with the salt as a passive factor? From facts so equivocal, evidently nothing can be derived that may serve as a principle for rational therapy.

It is, however, evident that even though we are able to achieve the ultimate refinement of accuracy in diagnosis of a renal lesion, treatment must depend very largely on our knowledge of the metabolism which usually accompanies this special clinical picture. Various tests may tell us something of the severity of the lesion, but nothing as to what measures are required to meet the impaired functional ability of the kidney, nor how to facilitate the irreducible minimum of its work.

These studies of the metabolism of patients with nephritis were carried on primarily in the hope of disclosing some facts which might be of help in the treatment of these cases. Years of observation, I must admit, have added only to my feeling of uncertainty and skepticism regarding the procedures commonly used, and in the absence of a single rational principle there seems no guide. It was the plan in this study to take certain definite conditions of diet, etc., as a basis, and to observe effects of alterations of single factors. Since it was desirable to continue observations over considerable periods, the diets often used in metabolism studies could not be employed because the patients too quickly tire of them. For this reason we used the ingredients of an ordinary mixed diet, only preserving some factors, e. g., nitrogen, at a minimum. Complete analyses were made of these diets. At once we meet an obstacle in the comparison of the protein metabolism of a normal man with that of a sick patient. The latter may have difficulty in eating a certain small ration which is quite inadequate for the man in health. Our controls are, on this account, not of so much service as in other studies where the patient is not so sick. They serve simply as a background of the normal response to a definite dietary regimen. As the fuel values of these diets hardly exceeds 1300 calories, it follows that the patient is usually insuffi-

ciently nourished; but it often happens that an adequate amount of food can not be ingested and retained by patients with nephritis at those periods of the disease where these investigations are most instructive. A consideration of the metabolism of undernutrition shows that no source of serious error of interpretation is introduced into the investigation by these conditions. If the food intake be below the immediate requirements of the organism for energy the deficit is made good at the expense of body fat (and stored glycogen). This loss becomes manifested in a fall in body weight. There is even in starvation a marked conservation of protein in the organism, and under conditions of slight undernutrition the protein destruction for energy or heat is extremely slight. Toxic protein destruction is another matter, and need not be considered when the temperature range is normal.

The second feature relative to the diets employed concerns the amount of nitrogen which was purposely reduced to a very low amount. The normal person is constantly tending to a condition of nitrogenous equilibrium between intake and excretion, and if protein food be much reduced there is a gradual fall in nitrogen excretion, until after a few days a balance is struck.

Nitrogen is retained to the body normally under two conditions only: during growth, when muscle tissue is being built up, and during convalescence, after periods of disease that have caused tissue destruction; both conditions demarked by gain in weight. Sharply contrasted with these normal states is the phenomenon peculiar to some types of nephritis wherein for periods of time the nitrogen excreted is considerably less than the intake, and there is, synchronously, a loss in, or stationary, body weight unless edema develops. These generally accepted facts which contrast the nitrogenous metabolism of some types of nephritis with the normal are briefly outlined as a basis for our further consideration.

Methods. The methods of study of metabolism in animals have been adopted, so far as possible, in this work. The ingredients of each diet were weighed before each meal, and particular care was exercised to see that all the food given to a patient was eaten. Like portions of food were taken from the ward pantry for analyses. The preparation of the food was intrusted to a competent nurse who understood and realized her duties. Urine was collected from 6 A.M. to 6 A.M., and at the latter time the patient was required to empty his bladder. The urine specimens were analyzed separately; the feces in periods. Unless specifically noted in the charts the nitrogen of the feces is deducted from the total nitrogen intake for the period.

Nitrogen Retention without Edema. From the study of metabolism in a series of cases of renal disease, it is observed that departures from the normal are noted chiefly in respect to nitrogen or sodium chloride. While with some cases the abnor-

mality affects only nitrogen with others, salt is also retained as well as nitrogen. The remarkable degree of nitrogen retention evidenced in some cases is not generally appreciated, and the pertinent question here arises, What becomes of this retained nitrogen? As an example of one of the questions at issue, the following case is cited when there was a retention of three grams of nitrogen per day.

CASE I.—W. H., aged forty-eight years. Admitted December 17, 1913, complaining of headaches and swelling of the face and ankles.

Excepting pneumonia in 1899, he had had no serious sickness. The present illness began about eighteen months before admission, with dyspnea on exertion. For six months there has been vomiting almost daily, sometimes two or three times a day. There was no gastric distress other than nausea. During this period severe headaches have been frequent, and there have been puffiness of the eyes and swelling of the feet. There have been no visual disturbances. The appetite has been good; bowels regular.

Examination. The patient is poorly nourished, with slight edema of the face. Retinæ hazy, but no exudate or hemorrhages. Moderate cardiac hypertrophy. Systolic retraction in fifth, sixth and seventh spaces outside the nipple; no evidence of valvular disease. Pulse is small and of low tension; blood-pressure, 134 mm. Hg. Liver enlarged, 10 cm. below costal margin in the right midclavicular line; smooth and not pulsating. Slight edema of legs and feet. Blood: hemoglobin, 80 per cent.; leukocytes, 10,000. Wassermann, negative. Urine: 1500 c.c.; specific gravity, 1009; albumin, +; casts, ++; leukocytes, +; phenolsulphonephthalein test, 28 per cent.

The edema subsided quickly and the liver became perceptibly smaller during the first week. The patient was apparently doing very well.

TABLE I.—METABOLIC STUDY OF PATIENT W. H.

Date, December.	Amount urine, c.c.	Nitrogen + albumin, gms.	Nitrogen, gms.	NaCl, gms.	Sulphur, gms.	Phosphorus, gms.	Weight, pounds.
19	1780	5.26	4.34	4.27	0.46	0.56	97¼
20	1570	4.19	3.83	3.30	0.41	0.38	96
21	1420	....	3.47	4.12	0.29	0.33	95
22	1550	....	4.14	5.43	0.36	0.30	92½
23	860	3.22	2.98	3.61	0.33	0.27	92
24	1860	5.40	3.95	7.02	0.41	0.34	87½
			22.71	27.75	2.26		
		Ingest	41.75	15.21			
Balance			+19.04	−12.54			

Fluid intake 500 c.c. daily. N : S = 10 : 1

On December 23 there was noted a weakness of the right hand, and the next day the patient showed distinct weakness of all muscles of the right half of the body, including those of the face. There was no change in sensation or of the reflexes. There was no disturbance of consciousness; no headache; no other prominent symptom. The patient felt well, except that he was naturally worried about his paralyses. All of these central symptoms cleared up during the next ten days, so that no residual of the paralyses was detectable.

The marked retention of nitrogen, increased until the climax, was of special interest with this history and in relation with the blood-pressure chart.

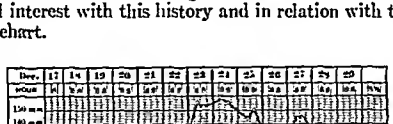

CHART I. Blood-pressure chart. W. H.

Several interesting considerations arise from the metabolic study. The edema which was evident on admission to the hospital subsided rapidly, and explains in part the rapid loss in weight. If this loss were all water it represents nearly five liters, which might seem improbable in view of the moderate edema detectable. There is, however, a difference of over five liters between the fluid ingested and the volume of urine excreted. This fact brings into prominence the lack of concord between the sodium chloride loss and water loss from that necessary for isotonic solutions in the body.

The salient features presented in the study of this case are: a normal water elimination and an apparent washing out of sodium chloride—negative balance—but at the same time marked retention of nitrogen with a climax synchronous with the development of a transient paralysis. The condition of affairs clearly parallels the uremic symptoms which von Leube cautioned are likely to follow the sudden subsidence of edema after diaphoresis. One is led to imagine here a loss of water only, and in consequence of this an increase in concentration of some excretory materials in the blood and tissues.[1] The highest concentration of nitrogen in the

[1] E. E. Butterfield has investigated a series of blood sera, using purely physico-chemical methods. The results are interesting and very significant. The physical changes in the sera of various types of nephritis mirror the more obscure chemical deviations from normal. Thus in the type of case under discussion the slight increase in specific gravity, dry residue, and refraction index means concentration, while the freezing-point indicates a disproportionate increase in some other ingredients.

urine is a little better than 0.2 per cent., and one is led at once to conjecture regarding the total nitrogen elimination had the urine volume been doubled. In other words, is the nitrogen excretion in any degree a function of the urine volume? This case is given, perhaps, unnecessary discussion, since it is in some essential particulars typical of a number that have been studied. It illustrates, as they all do, a relation that appears to obtain quite constantly between marked nitrogen retention and some of the terminal sequelæ of severe nephritis. When there is a rapid accumulation of nitrogen in the body under these circumstances, either uremia, apoplexy, or cardiac failure seems predictable.

It has been accepted that one of the characteristic phenomena of the type of nephritis under discussion is that the nitrogen concentration of the urine is low. While a normal urine may contain 2 or even 3 per cent. of nitrogen, with this form of nephritis the "kidney is not able to concentrate," and a liter of urine may contain even less than ten grams of nitrogen. Concentrations of much below 1 per cent. even when the fluid ingest is restricted are not of unusual occurrence. It would seem, then, from this that the completeness of elimination of excretory nitrogen is dependent upon the amount of diluting medium, other factors being equal; in other words, if the nitrogen to be eliminated is 12 grams, and the maximum concentration effected by the kidney 0.5 per cent., the necessary urine volume must equal 2400 c.c. We have made a number of observations which appear to support this conception.[2] With the following case, which is typical, the evidence recorded in the chart shows that a plus or minus nitrogen balance is dependent on the urine volume, that is, the fluid ingested. In all other respects the periods are exact duplicates.

CASE II.—H. K., aged forty years.

Past History. Patient had scarlet fever at five years of age and pneumonia when twenty-two. Has never been robust, but has been well. No history of nycturia or edema until two months ago. Venereal diseases denied.

Present illness began seven weeks before admission, with headaches, mostly occipital, but involving vertex and frontal regions at times. More recently there has been some shortness of breath, and the patient has grown weaker. At this time there was swelling of the face about the eyes and later some swelling of the ankles. The patient has noted that for the past month he has had thirst at night and passed much urine. There have been cramps in the legs.

This is further emphasized in differences between total dry residue and the protein under various conditions: Normal dry residue minus protein, 1.8; nephritis with edema, dry residue minus protein, 2.2; nephritis with uremia, dry residue minus protein, 3.3.

[2] We have studied 22 cases of nitrogen retention, and these reported represent fair examples.

TABLE II.—METABOLIC STUDY OF PATIENT H. K.

Date, April.	Amount urine, c.c.	NaCl, gms.	Nitrogen, gms.	Weight, pounds.	
9	900	2.88	5.06	119	Metabolic diet.
10	880	2.90	4.85		
11	1920	5.95	9.62		Fluids, 800 c.c.
12	1430	4.72	6.68	117½	
			26.21		
			28.86 (ingest)		
			+2.65 (balance)		
13	2090	6.69	9.64		
14	2190	7.88	11.29	117	Force fluids.
15	1940	6.01	9.31	116½	
16	2220	6.16	9.56		
			39.80		
			29.53 (ingest)		
			−10.27 (balance)		
17	1580	4.27	7.49	114	Milk, 1200 c.c.; water, ++
18	1500	3.45	6.86	113	
19	1840	3.49	8.93	112½	
20	1540	3.23	6.87	111	
21	1760	2.29	8.25	111	
			38.40		
			27.22 (ingest)		
			−11.18 (balance)		
22	1100	1.43	5.47	111	Metabolic diet + fluids, 500 c.c.
23	1030	1.24	5.30		
24	750	2.63	4.50		
25	850	1.02	5.34	111	
26	820	1.48	4.92		
27	910	1.55	5.93	112	
28	1180	2.60	6.68		
			38.14		
			51.10 (ingest)		
			+12.96 (balance)		
29	1360	3.12	7.43	112½	
30	1470	3.09	8.57	....	Force fluids.
May					
1	1480	3.26	6.02	114	
2	1330	2.79	7.75		
3	2290	4.12	11.12	114½	
4	2160	4.01	9.01		
5	2100	4.20	9.60	117	
6	1490	3.13	8.09		
7	1400	2.91	7.81	118	
8	1560	2.72	8.26		
9	1760	2.99	8.55	120	
10	1840	3.50	8.41	119½	
			100.65		
			89.57 (ingest)		
			−11.08 (balance)		

Examination. The patient was a rather poorly nourished man, and looked anemic. The examinations disclosed a moderate degree of cardiac hypertrophy and some edema of the legs. Blood: hemoglobin, 54 per cent., otherwise of no significance. Wassermann reaction negative. Blood-pressure, 178 mm. Hg. systolic. Urine: twenty-four-hour quantity, 1600 c.c.; specific gravity, 1012; albumin, ++; hyaline and granular casts and leukocytes. Phenolsulphonephthalein test; 5 per cent. recovered in two hours. After four days of observation the patient was given the measured diet. An initial diuresis on April 13 was due in part to edema fluid. On the next three days the patient was encouraged to drink water freely. The rise in nitrogen excretion is striking.

In the first period (April 9 to 12) there is a retention of two grams of nitrogen, a minus chloride balance, and a falling weight curve. The loss in weight continues until April 21, when the chloride balance is struck between intake and output. In the second period, April 13 to 16, there is a sharp increase in nitrogen excretion, so that in four days ten grams more nitrogen are excreted than ingested. As the patient began to tire of the diet a change was made to milk from April 17 to 21, involving a slight drop in the nitrogen intake. During this period the patient was urged to take water enough to make the total fluid ingested up to two liters. Here, again, the balance for the period shows a nitrogen loss to the body of eleven grams. The patient's condition had now become excellent, and he was kept in bed only to assure of accuracy in the study.

Thus far the nitrogen excretion has appeared to bear some relation to the volume of the urine. Is this the case actually? If it be so then a restriction of the fluid ingested should be accompanied by a retention of nitrogen in the body, *i. e.*, a plus-nitrogen balance. The fluid ingested was limited to 500 c.c. daily in the period April 22 to 28 and the metabolic diet was resumed. All other conditions were the same as in the earlier periods except that the patient was in much better condition. It is to be observed that the drop in the urine volume consequent upon limited fluid intake is at once followed by a fall in the nitrogen output. On no day did the urinary nitrogen equal the nitrogen of the food, and the period shows a retention of nearly thirteen grams. There was also a rise in the non-protein nitrogen of the blood at the end of the period. There is, then, in this case, an intimate relation between the nitrogen balance and the water excretion.

The increase of fluids in the next period points again to a washing out of retained nitrogen and a negative balance for the period.

One might be inclined to attribute the retention in the period April 22 to 28 to tissue regeneration, because there was a gain of a pound in weight; but this interpretation is negated by the continued gain in the following period, April 29 to May 10, when there was constant nitrogen loss.

A fact in relation to the chloride excretion deserves attention, since it is frequently noted in our studies. From April 9 to 21 the tendency is toward chloride equilibrium, with a more prompt excretion accompanying the periods when the urine volume is large. On April 21 the excretion is the same as the intake. During the next period there is a retention of a slight amount, followed by a negative balance in the final period.

This patient left the hospital in excellent condition and free from symptoms.

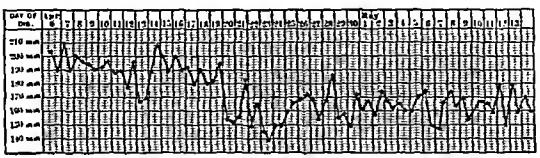

CHART II. Blood-pressure chart. H. K.

The relation between the urine volume and the nitrogen excretion appears with considerable constancy in this type of chronic nephritis. This case given in detail is not exceptional, but rather typical.

The following case presents the same essential factors as the last:

CASE III.—R. B., aged thirty-eight years.

Past History. Patient had scarlet fever in childhood and has had attacks of tonsillitis during his life. Patient was operated upon for appendicitis in 1903. At this time albumin was found in the urine. Has had no symptoms of renal disease until 1914. The patient contracted lues in 1896, and was treated. Several years ago he was treated again with salvarsan.

Present History. For three months there has been increasing dyspnea, especially at night. There has been some cough. He has lost in weight and his appetite is poor. Urine is passed freely, two or three times during the night. There has been very little headache, no visual disturbances, and no notable edema.

Examination. This disclosed slight cardiac hypertrophy, with a blood-pressure of 158 mm. Hg.; no edema; no retinal changes; hemoglobin, 78 per cent.; Wassermann doubtful. The urine amounted to 1075 c.c. for the first day. Specific gravity, 1013; albumin, heavy trace; a few hyaline casts. Phenolsulphonephthalein test, 7 per cent. The non-protein nitrogen of the blood was 88 mg. per cent.

This patient left the hospital much improved, although it was evident that the prognosis was definitely bad. The phenolsulphonephthalein test was never better than 10 per cent. for two hours. In a study conducted on this patient four months later it was found that his kidneys were unable to excrete more than eight grams of

nitrogen per day under any conditions. If the water ingested was adequate to secure a urine volume of 2400 c.c. or over, the nitrogen ran from seven to eight grams, irrespective of how large the protein intake might have been. If, on the other hand, the urine volume were low, the total nitrogen would be low.

TABLE III.—METABOLIC STUDY OF PATIENT R. B.

Date, March.	Amount urine, c.c.	NaCl, gms.	Nitrogen, gms.	Weight, pounds.	
16	1620	6.48	6.77	127	Metabolic diet, + 500 c.c. water.
17	1470	5.29	6.80	....	Non-protein N, 88 mg.
18	1400	4.90	7.66	124	
19	1390	4.45	7.53	123½	
20	800	2.40	4.25	123½	
			32.99		
			36.44 (ingest)		
			+3.45 (balance)		
22	1730	4.00	8.58	124	Increased water intake.
23	1950	3.40	7.56	125	
24	1900	4.20	8.58		
25	1400	3.45	7.54	124½	
26	1840	3.20	7.79	124	
27	1720	3.24	8.43	125	
28	2220	3.45	9.48	125½	
29	1520	1.92	5.16	125	
			63.12		
			50.75 (ingest)		
			−12.37 (balance)		

CASE IV.—D., aged forty years, tailor.

Family History. Father and mother died of old age.

Past History. Malaria in childhood. Has never been sick until the present trouble commenced, six months ago. Alcohol in moderation. Venereal infection denied.

Present Illness. This began six months ago, with headaches in the morning. The headaches were frontal at these times. The patient noted that the breath was foul. The headaches have increased in frequency and the patient has been attending Cornell Dispensary for relief. The eyes have been swollen at times, but not the ankles. He has had frequent urination for two weeks. No dyspnea.

Examination. Well-developed man; looks anemic; face somewhat puffy. Pupils react normally. Albuminuric retinitis on both sides. Thyroid normal. Lungs normal. Vascular: pulse equal, regular, of good force, tension increased; artery, sclerotic. Blood-pressure, 180 mm. Hg., systolic. Heart: precordial impulse heaving and not localized. Relative dulness from right sternal margin to 12 cm. to left in fifth, intercostal space. No murmurs. Aortic

second accented. Abdomen: normal. Liver and spleen: normal. Extremities: no edema; reflexes normal. Glands not enlarged except those in cervical region, which are palpable. Weight: 119.5 pounds. Blood: hemoglobin, 70 per cent. Erythrocytes, 5,000,000. White-blood cells, 18,000. Wassermann negative. Non-protein nitrogen, 132 mg. Urine: 1010 c.c.; specific gravity, 1012; albumin, very heavy precipitate. Many hyaline and granular casts; a few white-blood cells; no red cells. Phenolsulphonephthalein test on March 24, 11 per cent. recovered and a lactose test on the 25th showed no excretion up to fourteen hours. Phthalein test, April 7, 16.7 per cent. in two hours; and on May 5, after discharge, he returned to the hospital for the test, which was 14 per cent. The systolic pressure was irregular from day to day, with limits of 210 and 170 mm. Hg.

As this patient appeared very sick at the time of admission the metabolic diet was not used, but instead milk, in measured amounts, supplemented by arrow-root to increase the calorie value. The metabolic diet was commenced on April 15.

TABLE IV.—METABOLIC STUDY OF PATIENT D.

Date, March.	Amount urine, c.c.	Total nitrogen.	NaCl, gms.	Sulphur, gms.	Phosphorus, gms.	Weight, pounds.	
26	850	7.10	0.51	0.54	0.50	...	Non-protein N, 130
27	1160	10.47	2.90	0.63	0.68	116	mg.
28	1100	8.88	1.65	0.41	0.54		
29	1150	8.70	2.53	0.51	0.54		
30	1490	12.19	3.58	0.67	0.68		
31	1070	7.74	2.14	0.39	0.42	116	
		55.08	13.31	3.17			
	Ingest	45.17	15.66				
		−9.91	+2.35	balance			
April.							
18	2070	7.92	5.38	0.63	0.54	114	Force fluids.
19	2360	9.52	6.37	0.74	0.63		
20	1730	6.64	3.80	0.50	0.46		Non-protein N, 45
21	2910	11.00	8.15	0.82	0.73	116	mg.
		35.08					
	Ingest	29.26					
		−5.82	balance				

NaCl and nitrogen of feces substracted from ingest.

With Case IV there was a negative nitrogen balance attained with relative ease when the protein of the diet was reduced. The flushing out of nitrogen was accompanied by a fall in the non-protein nitrogen of the blood to nearly a normal concentration. The weight remained almost constant. In the second period the fluctuation of the chloride excretion with the urine volume was notable; a phenomenon already mentioned. Chloride metabolism

was not normal, although compensation is attained in an irregular manner; there was no evident edema.

This patient was discharged much improved and sufficiently well to be able to secure life insurance, as he confided to a house officer at the time of a "follow-up" call.

These cases are illustrations of more or less successful application of a principle to attain a definite result: the prevention of nitrogen retention and the washing out of nitrogen retained during some previous period. As a method in practice one must make every reservation as to its efficacy. The cases that are found in hospital wards are, for the most part, representative of advanced stages of the disease where but little benefit at best can be expected. We do not at present know whether periods of nitrogen retention accompany the earlier and often transitory manifestations of renal disease. It is possible only to cite the facts that when this faulty elimination persists for some period and is of a marked degree there ensues some of the phenomena characteristic of uremia. I do not believe we are even able to assert that the latter state is a consequence of retention and not merely an associated phenomenon.

Now it is self-evident that large amounts of fluid can not be taken by every nephritic without danger. Each liter of water ingested represents an appreciable extra burden thrown upon the heart muscle, and with nephritis of all types we find this muscle abnormal and especially so with these cases of nitrogen retention. Hence it follows that with every case caution is necessary, and with some the procedure might be, theoretically, hazardous. A slowly developing water retention has been noted in some cases without evidence of cardiac embarrassment, yet we have held this water retention to be of cardiac origin, and are supported in this belief by the fact that digitalis often causes a prompt elimination of the surplus.

With cases where the renal damage is so extensive that there is no margin of accommodation or where water elimination is impaired no result is secured by forcing of fluids.

The following case is of the latter type:

CASE V.—T. C., aged thirty-eight years.

Past History. Patient has never been confined to bed until the onset of his present illness. He has had slight rheumatic pains at times, but not of such severity as to require medical attention. In habits the patient is moderate; he has used a little beer occasionally, but very seldom whisky. He has had gonorrhea, but never lues so far as he knows, and gives no history suggesting infection. His normal weight is about 110 pounds.

Present Illness. Patient has had headaches for a week; prior to this symptom he believed himself in good health. Three days ago he noted that his face and eyes seemed puffy, but there was

no swelling elsewhere. The urine has been scanty for several days. The color was not noted. He has had no visual disturbances; no dyspnea or nausea.

Examination. Edema of face, especially about eyes. Moderate anemia; pyorrhea alveolaris; cardiac hypertrophy, with a faint diastolic murmur at the left sternal margin and a short systolic murmur at the apex. Pulse not Corrigan type. Lungs seem normal; abdomen normal. Slight pretibial edema; no glandular enlargement. Blood: hemoglobin, 65 per cent.; leukocytes, 6900. Wassermann negative (three tests). Blood-pressure, 160 to 130. Non-protein N, 180 mg. Urine: 800 to 1000 c.c.; specific gravity, 1014; albumin + +; casts and a few erythrocytes. Phenolsulphonephthalein test, 10 per cent. in two hours.

The patient was given the metabolic nephritic diet, beginning April 1. On April 13 this diet was changed to one of milk and arrow-root starch. The patient left the hospital improved so far as concerned symptoms. The headaches ceased and edema subsided. There was no change in the albuminuria. Two weeks after discharge he was readmitted with moderate edema, which disappeared promptly with the use of theocin. There was pronounced diuresis and a fall in weight from 112 pounds to 103 pounds.

TABLE V.—METABOLIC STUDY OF PATIENT T. C.

Date, April.	Amount urine, c.c.	Nitrogen, gms.	N + albumin, gms.	NaCl, gms.	Sulphur, gms.	Phosphorus, gms.	Weight, pounds.	
5	1080	7.08	8.25	4.75	0.44	0.29	110	800 c.c.
6	990	5.89	7.53	3.86	0.35	0.23		water.
7	1040	7.00	8.77	3.95	0.43	0.29		
8	770	4.74	6.54	2.62	0.32	0.15	111	
9	950	7.74	8.61	5.23	0.53	0.39		
10	680	4.46	5.74	2.04	0.34	0.12		
11	840	5.17	6.99	2.52	0.42	0.19	...	2800 c.c.
12	900	5.49	7.08	2.70	0.37	0.22	112	fluid
		47.57	59.51	27.67				
	Ingest	58.12		20.88				
	Balance	+10.55		−6.79			N : S	14 : 1
13	790	4.64	6.12	2.29	0.31	0.17	112	1200 c.c.
14	820	4.77	6.31	2.39	0.32	0.19		milk; 50
15	810	6.60	7.85	2.89	0.43	0.30	113	gms.
16	800	5.18	6.43	2.00	0.29	0.27		starch.
17	850	4.89	6.20	2.72	0.27	0.28	111	
		26.08		12.29				
	Ingest	28.75		10.41				
	Balance	+2.67		−1.88				
							N : S =	16 : 1

The patient returned to his home but did not attempt to work. Headaches returned in the latter part of May, and there was

dyspnea and some nausea. Edema did not appear. On June 2 the patient's wife noted twitching movements of the hands and face which alarmed her, and hospital aid was requested. The patient had an epileptiform convulsion in the ambulance and was admitted to the ward in coma. Death occurred the day of admission. No autopsy. Clinical diagnosis: chronic nephritis; chronic valvular disease (aortic insufficiency); uremia.

The table in this case shows a low urine volume, with no visible response to increase in fluid ingest; a small negative chloride balance and a marked tendency to retain nitrogen. The high non-protein nitrogen at the beginning of the study indicated that successful therapeutic measures would be marked by a negative nitrogen balance. This could not be secured. In the second period, with even further reduction in the nitrogen ingest, there still persisted a plus balance and the non-protein nitrogen practically unchanged. Here it was evident at the time of the first admission to the hospital that the rapid improvement in the patient's condition could not be continued nor were his kidneys adequate to any larger demands than those of a highly restricted diet. The discussion of cases such as this represents, naturally, focusses upon the nitrogen exchange, but the morbid state is hardly more evident with the nitrogen than with other elements concerned in protein metabolism; both sulphur and phosphorus excretion are below what they should be and there are no compensatory days. With these facts in view the terminal event is entirely logical and was expected.

Everyone who has studied the metabolism of cases of nephritis has observed a retention of amounts of nitrogen in excess of what can be explained by increases of the non-protein nitrogen of the blood. A retention of a gram a day is common, two or three grams a day for a couple of weeks not rare. What becomes of fifteen or twenty grams of nitrogen so retained by a patient whose condition excludes the idea of cellular growth? Not half this amount of nitrogen can be accounted for in the blood on the basis of the degrees of the non-protein nitrogen observed.[1] It is evident that the surplus must be in the tissues, either free or combined.

In an attempt to gain some light on this point a series of analyses has been carried out on various tissues from cases of nephritis in comparison with other diseases, and it is apparent that the non-protein nitrogen in tissues accumulates to a remarkable degree. This is true of muscle (psoas) and of liver tissue, whether of all we are not as yet prepared to state. The fact is mentioned in this place as an answer to questions already brought out in this paper.

[1] The normal non-protein nitrogen of the blood reaches its high level at about 40 mg. per 100 c.c.; 200 mg. per 100 c.c. is an exceptionally high figure with severe nephritis. The difference of 160 mg. per 100 c.c. accounts for 4.8 gms. nitrogen if the blood volume equal 3 liters.